MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

EPM1016 – INSTRUMENTATION AND MEASUREMENT TECHNIQUES

(TE / RE)

27 MAY 2019
2:30 PM – 4:30 PM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 6 pages including cover page with 4 Questions only.

2. Attempt **ALL** the questions. The distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

a) Define the terms *Accuracy* and *Precision*. Then label each target in Figure Q1(a) with either two of these phrases – high accuracy, low accuracy, high precision or low precision.

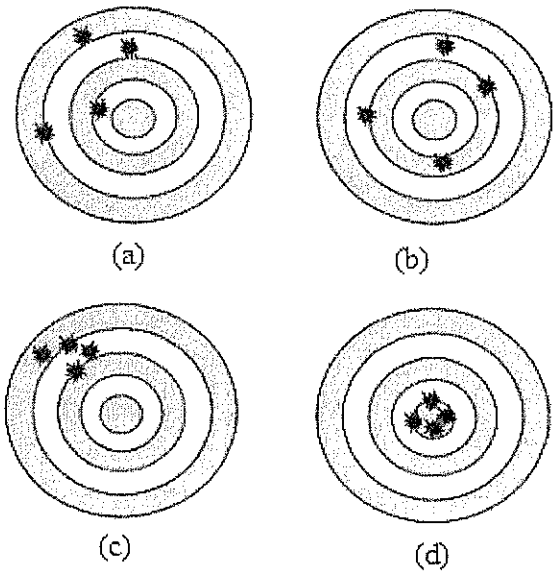

Figure Q1(a)

[4 + 4 marks]

b) Design a multi-range DC mili-ammeter with an internal resistance $R_m = 50\Omega$ and full scale deflection current of $I_m = 1mA$. The ranges required are 0 – 10 mA; 0 – 50mA; 0 – 100 mA and 0 – 500 mA. [4 × 2 marks]

c) For a dynamometer ammeter, the mutual inductance, M, varies with deflection θ as $M = -6 \cos(\theta + 30°)$ mH. Determine the

i. deflecting torque produced by a direct current of 50 mA corresponding to a deflection of 60°. [5 marks]

ii. current that will result in a 10° deflection. [4 marks]

Continued...

Question 2

a) Two wattmeters are used to measure the power consumed by the load of a star-connected three-phase system. Draw a circuit diagram, showing how power measurement can be done. If the two wattmeter readings are 45 kW and 24 kW, calculate the total active power consumed.

[6 + 2 marks]

b) A 15A, 235V energy meter carries a full load current at 0.8 lag. The meter runs at 500 rev/kWh at no error. Determine the

i. power consumed by the load in kW. [2 marks]
ii. time taken by the meter disc to make 20 revolutions. [4 marks]
iii. meter constant if there is an error of 15%. [4 marks]

c) With the aid of a table, compare the 3 three-phase power measurement methods in terms of load balancing and neutral point requirements.

[7 marks]

Continued...

Question 3

a) AC Maxwell-Wien Bridge in Figure Q3(a) is used to measure the resistance R_S and inductance L_S of a coil. Given the non-reactive resistor $R_2 = R_3 = 100\Omega$, balance is obtained with $C_1 = 0.016\mu F$ and $R_1 = 570\Omega$. Determine the value of R_S and L_S.

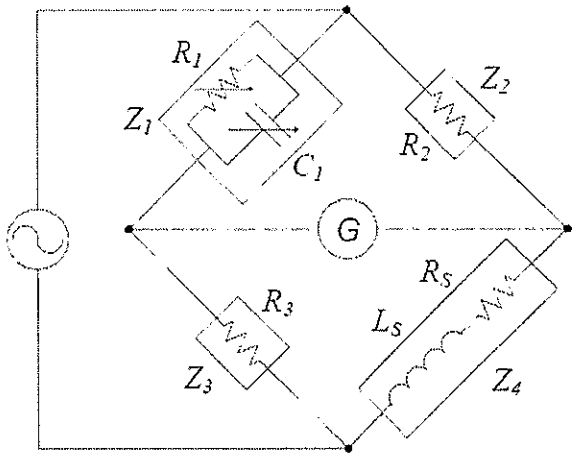

Figure Q3(a)

[10 marks]

b) If the inductance and resistance of an inductive coil is to be measured with Hay Bridge, draw a typical circuit diagram showing the setup of the measurement. Derive the equations for determining the unknown resistance and inductance of the inductive coil.

[5 + 6 marks]

c) An inductor can be represented by an equivalent circuit with an inductance L and a resistance R. Given operating frequency, $f = 1kHz$, $L = 12.6mH$ and $R = 570\Omega$, determine the theoretical Q-factor for a

i. series-RL connection. [2 marks]

ii. parallel-RL connection. [2 marks]

Continued...

Question 4

a) An iron ring with cross-sectional area of 10 cm^2 is made of two different type of materials; A and B, having μ_{rA} = 1000 and μ_{rB} = 1500. The mean length of both materials that form the iron ring are l_A = 80cm and l_B = 30cm, with an air gap of 2mm wide. A magnetizing coil of 1000 turns is wound around the ring and a current of 6A is flowing through it. Determine the flux produced in the air gap.
[Note: Neglect any fringing effect]

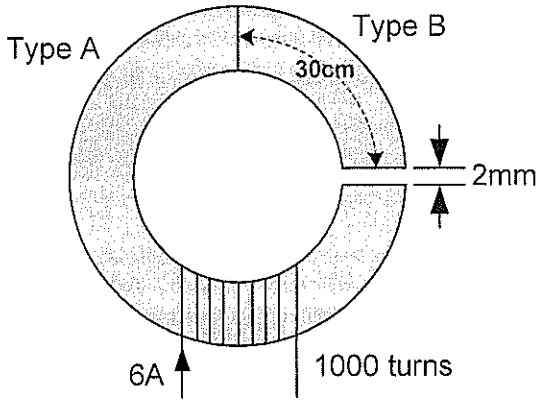

Figure Q4(a)

[11 marks]

b) A strain gauge shown in Figure Q4(b) has a fixed resistors R_3 and R_4 of 150Ω each and a variable resistor R_2 which is 110Ω at zero strain and 110.75Ω with the strain. The gauge factor is 2.54. Determine the strain, where the strain gauge is attached.

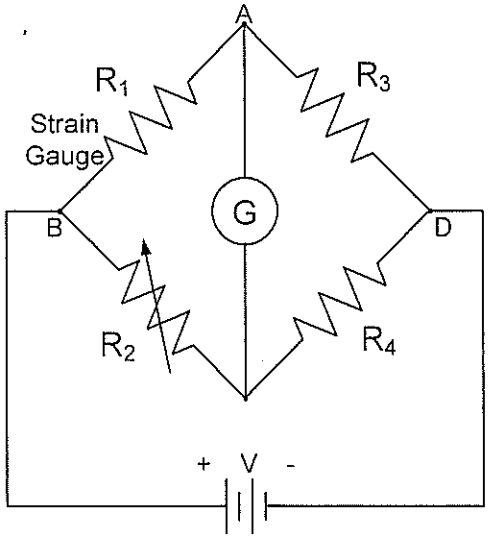

Figure Q4(b)

[8 marks]

c) A platinum thermometer has a resistance of 100Ω at 25°C.
   i. Determine its resistance at 65°C if the platinum has a resistance temperature coefficient of 0.00392/°C. [3 marks]
   ii. If the thermometer has a resistance of 150Ω, calculate its temperature. [3 marks]

End of paper.